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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte THIAN HOEY TIO

Appeal 2009-015000
Application 10/553,164
Technology Center 1700

Before CHARLES F. WARREN, CATHERINE Q. TIMM, and MARK NAGUMO, *Administrative Patent Judges.*

Opinion for the Board by TIMM, *Administrative Patent Judge.*

Dissenting Opinion by NAGUMO, *Administrative Patent Judge.*

DECISION ON APPEAL[1]

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[1] The two-month time period for filing an appeal or commencing a civil action, as recited in 37 C.F.R. § 1.304, or for filing a request for rehearing, as recited in 37 C.F.R. § 41.52, begins to run from the "MAIL DATE" (paper delivery mode) or the "NOTIFICATION DATE" (electronic delivery mode) shown on the PTOL-90A cover letter attached to this decision.

A. Introduction[2]

Thian Hoey Tio ("Tio") timely appeals under 35 U.S.C. § 134(a) from the final rejection[3] of claims 1-10, which are all of the pending claims. We have jurisdiction under 35 U.S.C. § 6. We AFFIRM.

The subject matter on appeal relates to processes of preparing synthesis gas, i.e., a mixture of carbon monoxide and hydrogen, by a partial oxidation reaction of a carbonaceous feed stock in a burner and by a steam reforming reaction of a carbonaceous feedstock. (Spec. 1, ll. 2-5.) The carbonaceous feedstock is preferably methane or natural gas (C_{1-4} hydrocarbons). (*Id.* at 4, ll. 8-10.) The steam and the natural gas are fed at a molar ratio of steam to carbon of less than 1 into a convective tubular steam-reformer reactor ("CSR"), resulting in a product that contains, in addition to CO and H_2, a relatively large portion of unconverted methane. (*Id.* at 2, ll. 16-19 and at 3, ll. 8-13.) The methane is later partially oxidized to CO and H_2 and the resulting synthesis gas converted into a hydrocarbons-containing stream via a Fischer-Tropsch process. (*Id.* at 3, ll. 23-29 and 10, ll. 15-23.)

[2] Application 10/553,164, *Process to Prepare Synthesis Gas*, entered the national stage on 5 July 2006, of an international application filed 13 April 2004, claiming the benefit of an EP application filed 15 April 2003. The specification is referred to as the "164 Specification," and is cited as "Spec." The real party in interest is listed as Shell Oil Co. (Revised Appeal Brief, filed 23 February 2009 ("Revised Br."), 2.)

[3] Office action mailed 15 June 2007.

Representative Claim 1 reads:

> 1. A process for the preparation of a gas containing hydrogen and carbon monoxide from a carbonaceous feedstock and its conversion to a hydrocarbons containing stream, the process comprising:
>
> (a) partially oxidizing a carbonaceous feedstock in a vertically oriented tubular partial oxidation reactor vessel having an upper end and a lower end, the vessel comprising a burner at the upper end, thereby obtaining an effluent comprising a first gaseous mixture of hydrogen and carbon monoxide;
>
> (b) catalytically steam reforming a carbonaceous feedstock by feeding a feed of steam and the carbonaceous feedstock to a convective steam reformer comprising a tubular reactor provided with one or more tubes containing the reforming catalyst, *wherein the steam to carbon molar ratio of the feed is below 1*, to obtain a steam reforming product;
>
> (c) feeding the steam reformer product to the upper end of the partial oxidation reactor to obtain a mixture of the effluent of step (a) and the steam reformer product; and
>
> (d) providing heat for the steam reforming reaction in step (b) by convective heat exchange between the mixture obtained in step (c) and the steam reformer reactor tubes thereby obtaining a hydrogen and carbon monoxide containing gas having a reduced temperature;
>
> (e) catalytically converting the hydrogen and carbon monoxide containing gas of step (d) using a Fischer-Tropsch catalyst into a hydrocarbons containing stream; and
>
> (f) separating the hydrocarbons containing stream of step (e) into a hydrocarbon product comprising 5 or more carbon atoms and a gaseous recycle stream comprising nitrogen, unconverted methane and other feedstock hydrocarbons, unconverted carbon monoxide, carbon dioxide, hydrogen and water and recycling the recycle stream to step (a) and/or (b).

(Claims App., Revised Br. 6; indentation and emphasis added.)

The Examiner has maintained the following grounds of rejection:[4]

A. Claims 1-9 stand rejected under 35 U.S.C. § 103(a) in view of the combined teachings of Fuderer,[5] Bertaux,[6] and Parkhurst.[7]

B. Claim 10 stands rejected under 35 U.S.C. § 103(a) in view of the combined teachings of Fuderer, Bertaux, Parkhurst, and Eilers.[8]

B. Discussion

Tio's sole contention is that:

> As noted above, the present invention has a steam to carbon molar ratio below 1. There is no teaching or suggestion in the Fuderer reference of having a steam to carbon ratio below 1. The ratio in the present invention is substantially outside the range of 2-4 disclosed in Fuderer. There is no overlap in the claimed ranges nor are the claimed ranges adjacent to each other. Accordingly, Applicants submit that a person of ordinary skill in the art could not optimize Fuderer within the disclosed ranges to obtain the presently claimed invention. It is only by hindsight that one of skill in the art having the teachings of Fuderer beforehand would be able to arrive at the present invention.

(Revised Br. 4.)

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[4] Examiner's Answer mailed 31 March 2008 ("Ans.").

[5] Andrija Fuderer, *Integrated Process and Apparatus for the Primary and Secondary Catalytic Steam Reforming of Hydrocarbons*, U.S. Patent 4,650,651 (1987).

[6] Jean-Marie Alexandre Bertaux et al., EP 0 776 959 B1 (1997).

[7] George L. Parkhurst, U.S. Patent 2,324,172 (1943).

[8] Jacobus Eilers et al., EP 0 668 342 A1 (1995).

The Examiner finds that there is a suggestion in Fuderer for using ratios outside the specifically disclosed 2/1 to 4/1 ratio that supports a conclusion of obviousness (Ans. 4-5 and 9-10).

The issue is: Does the evidence as a whole support the Examiner's findings and conclusions with respect to the steam to carbon molar ratio?

Because a preponderance of the evidence supports the conclusion of the Examiner, we answer this question in the affirmative.

With respect to the ratio of steam to hydrocarbon, Fuderer states:

> The ratio of steam to hydrocarbon feed will vary, as is known in the art, depending upon the overall conditions employed in the reforming zones. The amount of steam employed is influenced by the general requirement of avoiding carbon deposition on the catalyst and by the acceptable amount of methane remaining in the effluent gas under the reforming conditions employed. On this basis, the mole ratio of steam to hydrocarbon feed in the conventional primary reformer unit is *preferably* from about 2/1 to about 4/1.

(Fuderer, col. 8, ll. 47-56 (emphasis added).)

Under the flexible inquiry set forth by the Supreme Court, the examiner must take account of the "inferences and creative steps," or even routine steps, that an ordinary artisan would employ. *Ball Aerosol And Specialty Container, Inc. v. Limited Brands, Inc.*, 555 F.3d 984, 993 (Fed. Cir. 2009); *see also In re Aller*, 220 F.2d 454, 456 (CCPA 1955) ("where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation."). "All the disclosures in a reference must be evaluated, including nonpreferred embodiments." *In re Mills*, 470 F.2d 649, 651, CCPA 1972).

Appellant's discussion of the evidence overlooks the fact that the ratio of 2/1 to 4/1 disclosed by Fuderer is merely a preferred ratio. This fact, in itself, implies that other ratios could be used. Further, as pointed out by the Examiner, and not disputed by Appellant, Fuderer includes a broader disclosure indicating that the ratio of steam to hydrocarbon "will vary" and that it depends on conditions in the reforming zones (Ans. 4-5 and 9-10; Revised Br. 3-4). Fuderer provides guidance for the acceptable minimum concentration of steam: Enough steam must be used to prevent catalyst fouling, and convert acceptable amounts of methane (Fuderer, col. 8, ll. 49-53).

The evidence supports the Examiner's finding that the ratio is a result effective variable for which the optimum or workable ranges would have been obtained through routine experimentation. The fact that the preferred ratio does not overlap the claimed range does not negate the other evidence of record indicating that workable ranges outside the preferred range were within the capability of the ordinary artisan performing routine experimentation.

The Examiner further finds, without dispute by Appellant, that it was desirable in the reforming art to minimize the level of steam (Ans. 4; Revised Br. 3-4). Appellant offers no reasonable basis to believe that using ratios of steam to carbon below 1 was not within the capabilities of the ordinary artisan (Revised Br. 3-4).

Weighing the evidence as a whole, including the evidence relied upon by Appellant, we determine that the evidence supports the Examiner's conclusion of obviousness.

C. Order

We sustain the rejection of claims 1-9 under 35 U.S.C. § 103(a) in view of the combined teachings of Fuderer, Bertaux, and Parkhurst.

We sustain the rejection of claim 10 under 35 U.S.C. § 103(a) in view of the combined teachings of Fuderer, Bertaux, Parkhurst, and Eilers.

Accordingly, we affirm the decision of the Examiner.

AFFIRMED

NAGUMO, *Administrative Patent Judge*, dissenting.

The majority faults Tio for failing to acknowledge that the range of steam-to-carbon molar ratio of 2-4 disclosed by Fuderer as the feed for the conventional primary reformer unit is "merely a preferred ratio." (Majority Opinion 6.) Tio, in the passage quoted *supra*, does not dispute that the feed ratio was known to be result-effective over that range. But Tio does deny that Fuderer provides any teaching or suggestion that would have led the person having ordinary skill in the art to pass a steam-to-carbon molar ratio less than one into the conventional primary steam reformer described by Fuderer.

The difficulty with the Majority's position is that the prior art must provide evidence that a particular parameter was recognized as being a result effective variable in the range recited in the claims. *Application of Antonie*, 559 F.2d 618, 620 (CCPA 1977). However, neither the Examiner nor the Majority has pointed to any credible evidence in the record that operation of a tubular steam reforming reactor at steam-to-carbon molar ratios less than one was recognized as an effective regime for any purpose consistent with the goals of Fuderer. In my judgment, the general principles on which the Majority and the Examiner rely are insufficient to show such recognition at the time the invention was made.

The Examiner does not rely on the secondary references to cure this defect. Accordingly, I would reverse the rejections for obviousness and I must, respectfully, dissent.

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